ARIZONA TRANSPORTATION RESEARCH CENTER

RESEARCH NOTES:

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Estimating the Cost of Overweight Vehicle Travel on Arizona Highways

Highlights

- Overweight vehicle enforcement remains a problem in most U.S. states.
- Hard data on overweight vehicles is sorely lacking.
- There is no coherent vision of weight enforcement among practitioners.
- Ports-of-entry (POEs) are not consistently manned and operated.
- When POEs are closed, the highways are ripe for overweight violators.
- There are few ports equipped with cutting edge technology to adequately identify overweight truck violations
- Overweight vehicles impose between $12 and $53 million/year in uncompensated damage to Arizona roadways.
- Expansion of mobile enforcement could have a 4.5 to 1 benefit/cost ratio.

Background

Pavement fatigue is proportional to repetitive loadings. These loadings, attributed to increases in traffic, are causing pavement damage at earlier, faster, and costlier rates. The volume of truck traffic has increased rapidly as the Interstate Highway System has become available and popular. The overloaded truck, whether legal or illegal, contributes to premature pavement fatigue.

Overweight vehicle enforcement remains a problem in most U.S. states. As our survey demonstrates, the port and mobile enforcement crews are understaffed and/or under funded. Some lack qualifications or skills necessary to adequately detect and monitor overweight trucks. There are few ports equipped with cutting edge technology to adequately identify overweight truck violations. Some ports are closed more hours than they are open. These circumstances lead to an inadequate enforcement of penalties for illegal overloads. Operators of illegally overloaded vehicles may also escape fines due to the failure of the judicial or administrative procedures dealing with detected violators. Billions of dollars are spent each year to replace and repair U.S. highways. Yet, less than 1% of the trucks are weighed at some ports-of-entry. Fines for illegal overloading are, therefore, not often correlated with the actual cost of pavement damage. Effectively monitoring and controlling truck weights are paramount to road preservation and minimization of pavement costs.

Ultimately, the regulations that U.S. states uphold are intended to balance the economic benefits of commercial vehicle operations, particularly through large trucks.

Nearly everything we own, eat, use, grow, or manufacture is carried by truck at least part of its journey. Trucks are vital to the economy; illegal overweight trucks are not.

Approach

Through survey techniques and a canvass of the literature, this study identifies the methods and expenditures that other states use to deal with overweight vehicle issues and mobile enforcement units. Arizona currently budgets about $5.8 million per year for mobile enforcement efforts aimed at, among other things, penalizing and deterring overweight vehicle operations in nearly 113,642 square miles of Arizona land area. We used the *ADOT Simplified Highway Cost Allocation Model* to estimate the damage that overweight vehicles impose on Arizona roadways.

Findings

The survey showed that hard data on overweight vehicles is sorely lacking. The range of estimates for the percentage of vehicles that are overweight ranged from less than one-half-of-one-percent to a high of 30%. Some perceive a serious problem. Others see no significant problem. No state was able to produce a credible estimate of the amount of damage that might be attributed to overweight vehicles.

There is no coherent vision of weight enforcement that permeates the thinking of practitioners. Some enforcement personnel imagine they are weighing nearly every truck. The reality is that only a minority of trucks is likely weighed. Ports-of-entry are not consistently manned and operated. When POEs are closed in the evenings or on weekends the highways are open for overweight violators.

We obtained estimates of the total cost of heavy vehicle use of the highways. One of these estimates came from the *ADOT Highway Cost Allocation Model* employed by the ADOT Financial Management Services Section. This model, which estimates vehicle cost responsibility, indicated that, at present, heavy vehicles account for about $170 million per year in planned state highway expenditures. State highway expenditures, though, represented only one-fourth of total outlays for roads in Arizona. Local government expenditures accounted for the other three-fourths of total outlays.

The share of expenses due to heavy vehicles for roadways under the jurisdiction of local governments is far smaller than it is for state highways. Most of the heavy vehicle miles of travel are on state highways. Relatively few of the miles are on other roads and streets. Consequently, the estimated amount of local government roadway expenditures attributable to heavy vehicles is probably about one-fourth as large as it is for state highways. This would amount to around $40 million per year. So, in terms of what is actually spent on roadways, heavy vehicles accounted for around $210 million per year.

Some would contend that planned expenditures might understate the real cost of serving heavy vehicles. Pavement damage is insidious and incremental. Preservation efforts may be deferred or inadequate to keep pace with actual wear. The USDOT estimates that nationwide, between 2001 and 2020, the cost to maintain pavements at the current level of service will amount to around $600 billion (exclusive of bridge-related expenditures). Annualized, this comes to $30 billion per year. Based on traffic, Arizona's share of this anticipated cost would be around 1.4% or about $420 million per year.

The annual costs of $210 million to $420 million estimated above are for all commercial vehicles. The share of roadway costs attributable to the heaviest vehicles (those 75,000 lbs. or more) is about 75% of the total. This would bring the range of costs incurred from the heaviest vehicles to between $155 million and $315 million per year. Costs are partially offset by revenues from these heaviest vehicles amounting to around $90 million per year. This means there is a shortfall of revenues compared to the expenses incurred to provide roadways for these vehicles. Based on the estimates made here, the shortfall would range between $65 million and $225 million per year.

This shortfall applies to all commercial vehicles over 75,000 lbs. The shortfall that is attributable to overweight vehicles is a share of this total.

To estimate the share of the revenue shortfall that is allocated to overweight vehicles we must estimate the percentage of commercial vehicles that are overweight and the added impact on pavement consumption caused by the excess weight. Since operating overweight vehicles without a permit is illegal, information on its extent is hard to come by. Violators work diligently to conceal their activities. Only a tiny fraction of violations are detected and punished. Consequently, estimates of the extent of illegal activities are prone to wide ranges of error. Published estimates of the percentage of commercial vehicles that might exceed weight limits vary widely. A brief recapitulation of these estimates reported in this study is shown in Table 18.

These data suggest that the percentage of overweight vehicles is probably in the range of 15%. Two of the estimates and the high-end figure from our survey imply that the percentage may be higher. The 38% overweight estimate for "run-by" trucks (those intentionally bypassing weigh stations) suggests a higher percentage might be correct. The 25% overweight vehicles passing through the weigh station in Connecticut imply a much higher violation percentage since drivers who know their vehicles are overweight are likely to take efforts to evade the weigh station. Hence, our decision to work with a 15% overweight percentage seems moderate and maybe conservative.

Assigning a straight 15% share of the uncompensated costs of commercial vehicles ($65 to $225 million) to the overweight category would produce a range of costs between $10 million and $35 million per year. However, this would understate the overweight vehicles' share of these costs because pavement damage increases exponentially with axle weight.

Based on data from the North Dakota Highway Patrol, the range of excess weight falls between 3,000 and 8,000 lbs. Since the tractor unit normally accounts for about 18,000 lbs., this range implies that, on a total weight basis, overweight trucks are 5% to 13% over the legal load limit. However, for pavement damage purposes it is the axle weight that is most critical. The 3,000 to 8,000 lbs. needs to be distributed over the load-bearing axles of the trailer. The range of over-weight would be about 4.5% to 12% per axle, if the over-weight is distributed between two tandem axles (two side-by-side axles, each with four wheels).

Using the 4.5% figure and the fourth-power exponential (1.0454) would give us an overweight vehicle share of between $12 million and $40 million per year. Each overweight vehicle would exert about 19% more damage than a truck operating at the 80,000 lb. legal limit. Thus, the overweight vehicle share of the costs should be 19% higher than it would be if the vehicle were operating at the legal limit. Using the 12% figure and the fourth-power exponential (1.124) would give us an overweight vehicle share of between $15 million and $53 million per year. Each overweight vehicle would exert about 57% more damage than a truck operating at the 80,000 lb. legal limit. Thus, the overweight vehicle share of the costs should be 57% higher than it would be if the vehicle were operating at the legal limit.

Thus, our best guess is that overweight vehicles impose somewhere between $12 million and $53 million per year in uncompensated damages to Arizona roadways. Arizona currently budgets about $5.8 million per year for mobile enforcement efforts aimed at, among other things, penalizing and deterring overweight vehicle operations. If a doubling of the mobile enforcement budget were 50% effective toward the objective of eliminating overweight vehicles from Arizona roadways, the savings from avoided pavement damage would range from $6 million to $27 million per year. At the lower figure, the expansion of mobile enforcement would be a little better than a "break-even" proposition. The savings from avoided pavement damage would slightly exceed the cost of the program. Any safety gains from detecting and taking out-of-service vehicles with safety deficiencies would come on top of the pavement damage avoidance gains. At

the higher figure, the expansion of mobile enforcement would have between a four- to five-to-one benefit/cost ratio. That is, for every one dollar invested in motor carrier enforcement there would be $4.50 in pavement damage avoided.

Conclusions & Recommendations

Our findings are, generally, in agreement with those reported by the State of Arizona Office of the Auditor General in 1997. We recommend a uniform system of weighing, recording, and reporting data in an automated, national, and international database. Ideally, such a system could also be linked through driver's licenses. Remote methods of data collection are also encouraged. These techniques would not only be an asset in intrastate travel, but also in interstate travel. An automated system would allow the MVD and other government agencies, interstate, intrastate, and internationally, to track overweight vehicles, monitor suspicious activity, and recover funds associated with violators.

We also recommend a study on which types of vehicles (e.g., car carriers, garbage dump trucks, rock haulers, etc.) are subject to the most overweight violations. This way, mobile enforcement crews can target or clamp down on vehicles more likely to be in violation of weight limits.

Through quantification of damage to the Arizona highways, we may now plan operational and maintenance strategies for potential investment assessments. Arizona highways serve as a vital mode of freight shipments. Highway freight hauling contributes over $250 billion to the economy each year. More funds need to be appropriated toward mobile enforcement staff and technology to meet the demands of a state facing rapid growth and highway transportation. Overweight vehicle enforcement merits improvement for effective monitoring and ticketing strategies to increase pavement design maintenance and life.

Table 18: Estimates of the Percentage of Overweight Vehicles

Estimate	Source
15%	General Accounting Office report[1]
10% to 25%	Transportation Research Board report[2]
38% of "run-by" trucks	Virginia Transportation Research Council report[3]
25% passing through weigh stations in Connecticut	WasteAge[4]
<1% to 30%	Survey responses[5]

The full report *Estimating the Cost of Overweight Vehicle Travel on Arizona Highways*, Final Report 528 by Sandy H. Straus, ESRA Consulting Corporation, 1650 South Dixie Highway, Third Floor, Boca Raton, Florida 33432, Telephone: 561-361-0004, e-mail: shs@esracorp.com and John Semmens, Arizona Transportation Research Center, Arizona Department of Transportation, 206 S. 17th Ave., MD 075R, Phoenix, AZ 85007 (Arizona Department of Transportation, report number FHWA-AZ-04-528, published November 2005) is available from the Arizona Transportation Research Center, 206 S. 17 Ave., Mail Drop 075R, Phoenix, AZ 85007; phone 602-712-3138, and on the web: http://www.azdot.gov, http://www.esracorp.com

[1] General Accounting Office. 1979. *Excessive Truck Weight: An Expensive Burden We Can No Longer Support*. Washington, D.C.
[2] Terrell, R.L., C.A. Bell, *Effects of Permit and Illegal Overloads on Pavements*, NCHRP Synthesis 131, Transportation Research Board, 1987.
[3] Cottrell, B.H., *The Avoidance of Weigh Stations in Virginia by Overweight Trucks*, Virginia Transportation Research Council, Charlottesville, VA, 1992.
[4] Shanoff, B. 1994. "Overweight Trucks Face Hefty Fines." *WasteAge.* Available from: http://www.wasteage.com/mag/waste_overweight_trucks_face/
[5] ESRA survey conducted for this study.